Space Weather Technical Forecast

Issued on Saturday, 26 March 2022 at 12:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storm intervals days 1-3 (26th-28th), including potential CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low with the largest flare a B8 from AR2976 at 25/1906 UTC. AR2976 Eho/Beta and AR2975 Cso/Beta in the northeast form a wider sunspot complex but have become largely stable through the last 24 hours. The much smaller group AR2974 Hrx/Alpha (which produced the M1 flare on 25th) has been inactive.
No Earth directed CMEs (coronal mass ejections) have been observed.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1 slowly declined from around 430 km/s to 400 km/s. The density was around average throughout. The strength of the interplanetary magnetic field (IMF), Bt, was weak mostly below 5 nT, with the north south component Bz ranging -5 nT to +3 nT, but often negative. Phi angle was predominately positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at Background levels. The high energy electron flux (greater than 2MeV) has been predominantly at Normal Background levels, with the 24-hour integrated electron fluence rising slightly, but well below the Active (1e8 integrated pfu) threshold. Observed fluence at 26/0000 UTC was 1.82e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Very Low, but with a slight chance (10%) of further isolated M-flares possible.

Solar Wind / Geomagnetic Activity: The 25th March CME arrival is expected 27/2300 +/- 10 hours, likely with a glancing impact, although some uncertainty. Fast wind of CH69 is expected to enhance solar wind across Earth later day 1 (26th), and through day 2 (27th), with solar winds then likely remaining enhanced into day 3 (28th) due to the anticipated CME. Solar winds easing again day 4 (29th). Quiet, isolated Unsettled geomagnetic activity will become Active with a chance of G1/Minor Storm intervals from the arrival of CH69 later day 1 (26th) and into day 2 (27th), and then again later day 2 and into day 3 (28th) from CME arrival. Activity likely easing to Quiet to Unsettled day 4 (29th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels throughout the forecast period, with only a very slight chance of rising above background levels from the one large sunspot on the disc. The high energy (greater than 2 MeV) electron flux is currently at background, with a chance of rising to Moderate to High in response to the fast wind of CH69, but with a likely period of drop out with the CME arrival either late 27th or early 28th. The associated 24 hr fluence will likely persist below the Active (1e8 integrated pfu) threshold but with a slight chance of rising above day 3 or

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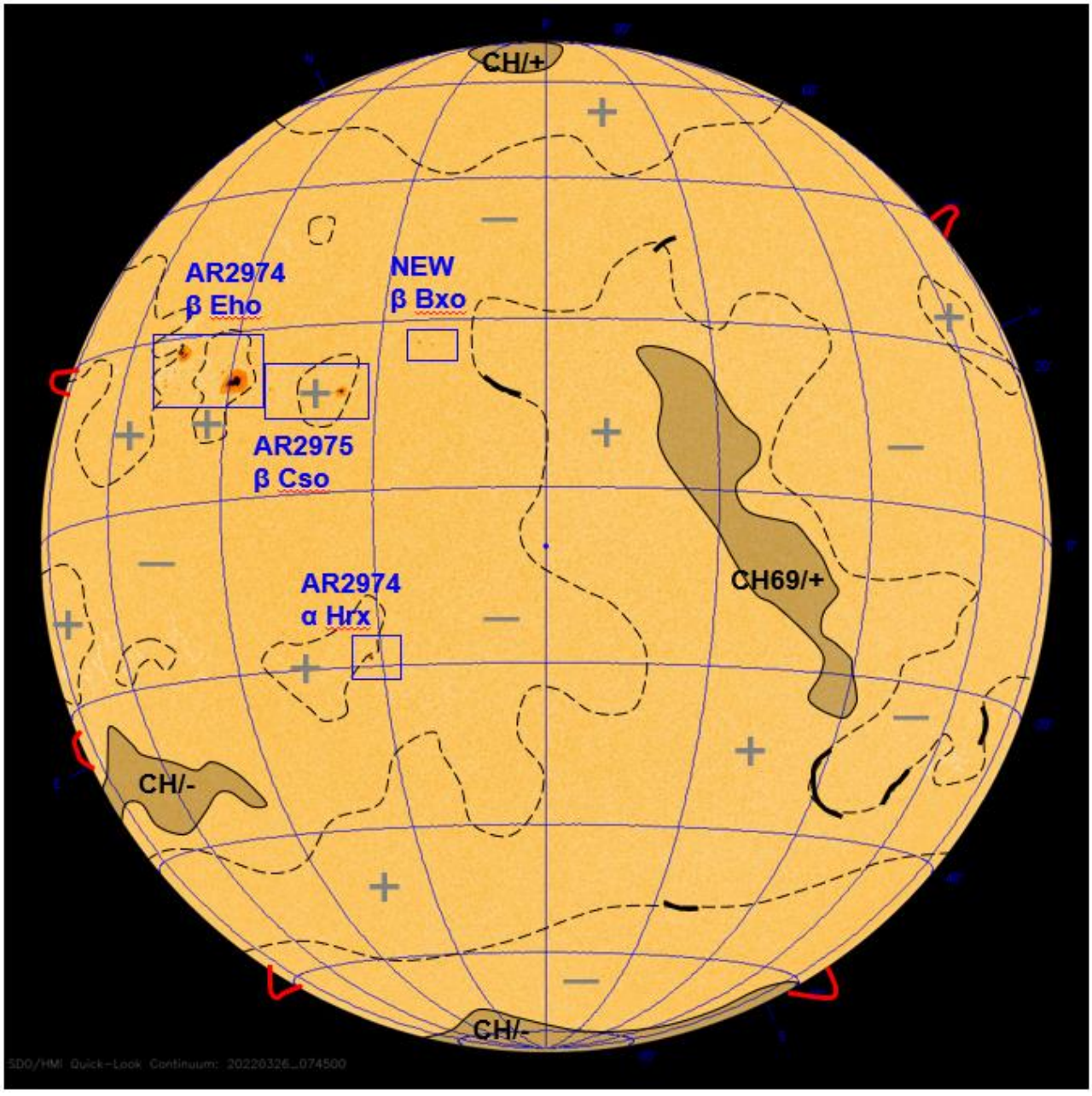
4 (28th or 29th).

Figure 1. Solar Analysis Valid 26/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is a CME which has the potential for a glancing impact at Earth, from the M1.5-flare of AR2974 on the 25th. There is some notable uncertainty with the timing of this CME, and extent of impact, due to a difficult assessment on the westward extent of the CME in available imagery. Current expected arrival time is 27/2300 UTC +/- 10 hours.
Solar winds are expected to become enhanced later day 1 (26th) due to the arrival of the fast wind of CH69. This is in-line with observations at STEREO A, which observed an enhancement around 24/0400 UTC, and observing conditions around 2.6 days ahead of Earth. This is supported by Enlil, which also indicates a slight speed increase late on the 26th or early 27th. These elevated winds will persist day 2 (27th), and likely stay enhanced day 3 (28th) due to the CME arrival.

Quiet, isolated Unsettled geomagnetic activity will become Active with a chance of G1/Minor Storm intervals from the arrival of CH69 later day 1 (26th) and into day 2 (27th), and then again later day 2 and into day 3 (28th) from CME arrival. Activity likely easing to Quiet to Unsettled day 4 (29th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	40	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/1225 UTC	Halo	AR2974 M1.5 flare	12S 20E	560 km/s	27/2300 UTC +/- 10 hrs	Uncertainty with analysis – glancing blow likely

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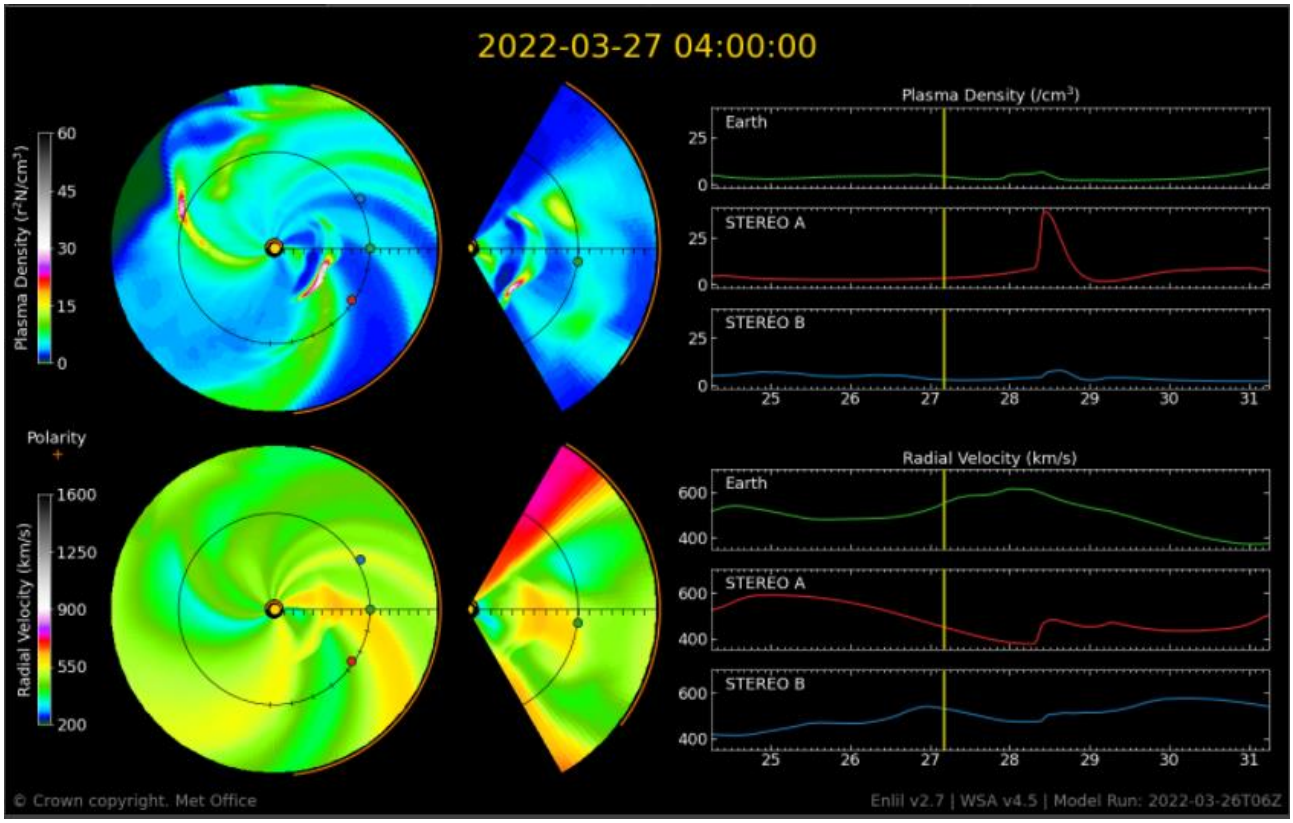
Figure 2: Enlil output showing expected increase in solar wind from CH69, also with likely 25th March CME glance.



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Radio Blackouts - X-Ray Flares:

There are currently three numbered sunspot groups on the Earth-facing disc, all located in the eastern hemisphere. AR2976 is the largest group in the northeast quadrant, and appears to be maturing into a more stable open region, whilst the trailer of nearby much smaller group, AR2975, continues to decay. AR2974 (in the southeast quadrant) was the source of the M1 flare on 25th, but remains a small and simple unipolar spot. A new, as yet un-numbered region, has also developed to the west of AR2975, although currently contains just two weak spots.

Also of interest is a bright flux region on STEREO A euvi imagery, that corresponds to a region identified on far-side products, and expected over the east limb later day 1 and into day 2 (26th/27th). This also has the potential to be a source of activity.
Solar activity is expected to be Low to Very Low, but with a slight chance (10%) of further isolated M-flares possible.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is currently expected to remain at Background levels throughout the forecast period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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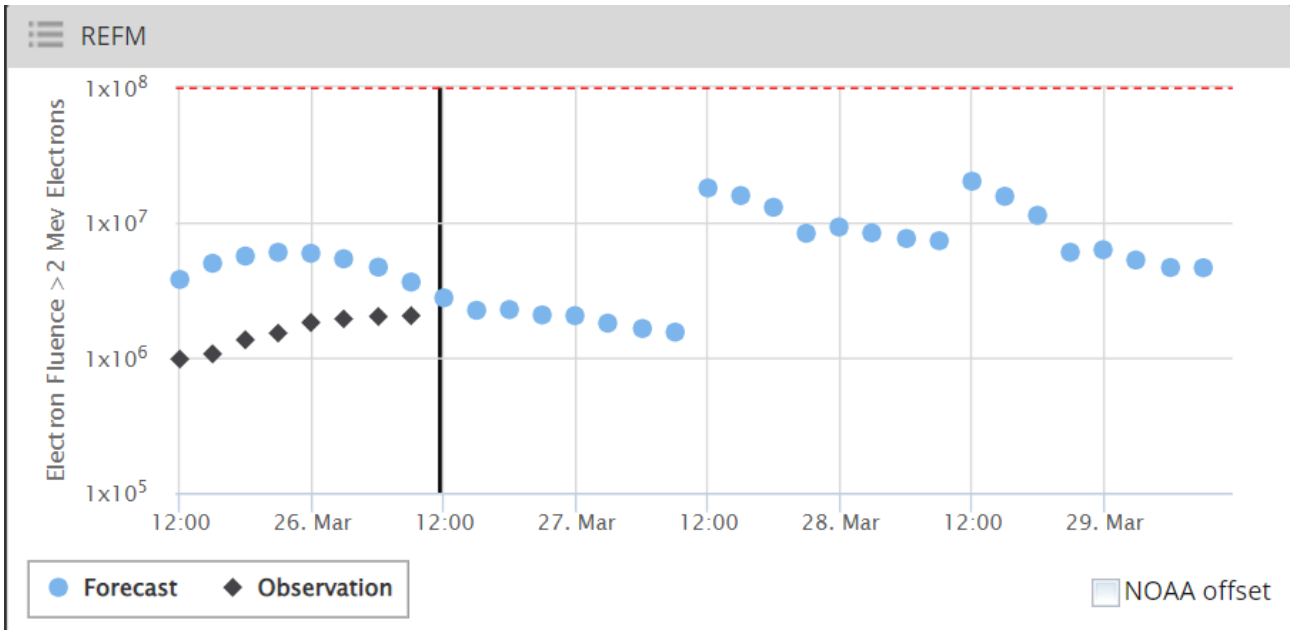
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO is currently at Background but likely to rise day 2 (27th) due to the arrival of the fast wind of CH69. This is further complicated by a likely CME arrival either late 27th or early 28th, likely causing a drop out to observed flux levels when it arrives. Despite this, periods of Moderate to High are possible on the 27th, and perhaps returning once any CME affects subside.

The associated 24 hour fluence is expected to rise from any moderate to high flux from the fast wind of CH69, although likely staying below the Active threshold, due to the potential CME arrival. However there is a slight chance that Active fluence does develop, with some uncertainty around the strength and timing of the CME. REFM is currently giving good guidance up to T+24, with fluence forecast to remain below the threshold. However beyond this period, any fast wind influence is likely to increase fluence above REFM values.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	20	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: MOSWOC REFM



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